

CONFLICT RESOLUTION ADVISORY  
PROJECT IMPLEMENTATION PLAN



August 28, 1991

**DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION**

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**Initiated By:** ANA-300

## RECORD OF CHANGES


**DIRECTIVE NO.**

7110.106

[illegible]

## FOREWORD

This order directs affected organizations to take necessary action to implement the Conflict Resolution Advisory (CRA) function in the 20 Air Route Traffic Control Centers. Management responsibility for this project has been assigned to the Program Manager for En Route Automation/TMS, ANA-300. Support and cooperation from the groups listed within this order are essential for the successful implementation of CRA.

  
Harry A. Kane  
Program Manager for En Route Automation/TMS



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## CHAPTER 1. GENERAL

1. PURPOSE. This order transmits the Conflict Resolution Advisory (CRA) Project Implementation Plan to the field. The document delineates activities, responsibilities, and schedules necessary for the implementation of the CRA function in the National Airspace System (NAS).
2. DISTRIBUTION. This order is distributed to the division level in the offices of the Program Director for Automation, Air Traffic Program Management, and Training and Higher Education; Air Traffic Rules and Procedures, Air Traffic Plans and Requirements, Systems Maintenance, NAS Transition and Implementation, and NAS System Engineering Services; division level to regional Airway Facilities and Air Traffic divisions; division level at the Aeronautical Center and the FAA Technical Center; and Airway Facilities and Air Traffic Air Route Traffic Control Centers (ARTCC).
3. DEFINITIONS. The following are definitions and acronyms which are used in this order but are undefined in reference documentation.
  - a. ATRDEV04. Developmental Host Computer System (HCS) baseline used for the development of CRA. The baseline consists of the A4e0.3 software with some enhancements planned for the A4e0.4 release. For the CRA development effort, the Mode C Intruder/Conflict Alert Enhancement (MCI/CAE) software planned for the A4e1.1 release has also been added to the baseline to support CRA requirements in Configuration Control Decision (CCD) 12355.
  - b. Conflict Resolution Advisory Upgrade (CRAU). Task designated in the En Route Software and Development Support (ERSDS) contract to uplevel the CRA 9020 software to the ATRDEV04 HCS baseline.
  - c. Conflict Resolution Advisory Enhancements (CRAE). Task designated in ERSDS contract to incorporate the CRA requirements delineated in CCD 12355 into the CRAU ATRDEV04 software. The functional capability of this software will be upleveled and incorporated into a national field release.
4. AUTHORITY TO CHANGE THIS ORDER. The Program Manager for En Route Automation/TMS, ANA-300, may issue changes to this order necessary to implement the project.
- 5.-19. RESERVED.





## CHAPTER 2. PROJECT OVERVIEW

20. SYNOPSIS. The present NAS en route software provides automation aids to detect and notify the controller of actual or potential violations of separation thresholds. The software which performs this function is Conflict Alert (CA). For detected conflicts in which separation standards have not been violated, the CA software will call on CRA to compute, rank, and validate an optimal resolution for display to the air traffic controller. In cases of multiple conflict pair configurations, the resolution may contain up to two required maneuvers to resolve the potential conflict. The resolution will be displayed to the controller as part of the CA tabular list. Possible resolutions include right or left turns with magnitude provided in degrees, climb or descend maneuvers to designated altitudes, or maintain altitude for aircraft in vertical transition. All resolutions will be validated against neighborhood traffic to ensure that a conflict free path is provided for 4 minutes from the time the resolution is first displayed. This order provides direction for the implementation of the CRA software enhancement into the HCS A4e1.2 software release. The CRA function provided in this release will be used at the 20 continental U.S. ARTCC's.

21. PURPOSE. Although CA provides automatic controller notification of potential conflicts, there is currently no automation aid to assist the controller in resolving the potential separation violation. In situations of heavy traffic, complex traffic patterns, or multiple aircraft conflicts, the notification of an impending separation violation within 2 or 3 minutes may not afford the air traffic controller sufficient time to formulate a plan to resolve the situation and to coordinate that plan with the aircraft of concern. CRA will provide a tool for the controller to resolve these conflicts in a safe and efficient manner. The HCS CRA development effort provides a valuable baseline to the developers of the Advanced Automation System (AAS) CRA function. Benefits to the AAS CRA function include a better understanding of end user operational requirements and extensive data provided from HCS CRA human factors and operational tests.

22. HISTORY. Functional CRA software based in the 9020 computer system was delivered to the FAA in 1984 under the auspices of a research and development contract. This software package was based upon the functional requirements defined in the MITRE specification En Route Conflict Resolution Advisories: Functional Design Specification (April 1981). Computer Sciences Corporation (CSC) was awarded the ERSDS contract in 1989 to develop HCS software for field implementation. Task II of the contract, CRA development, is broken into two sequential tasks designated as CRAU and CRAE. The first task is limited to the transfer of the existing CRA functional capability from the 9020 system to the HCS. The second task, CRAE, calls for the incorporation of numerous enhancements to the HCS CRAU software. The original enhancements were based on the requirements delineated in CCD 9794 (August 1987). During detailed review of CCD 9794 by air traffic representatives, many of the documented enhancements were modified and new ones were added. These changes and additions were delineated in CCD 12355 (June 1990) which superseded the original requirements document. In November 1990, the ERSDS contract was

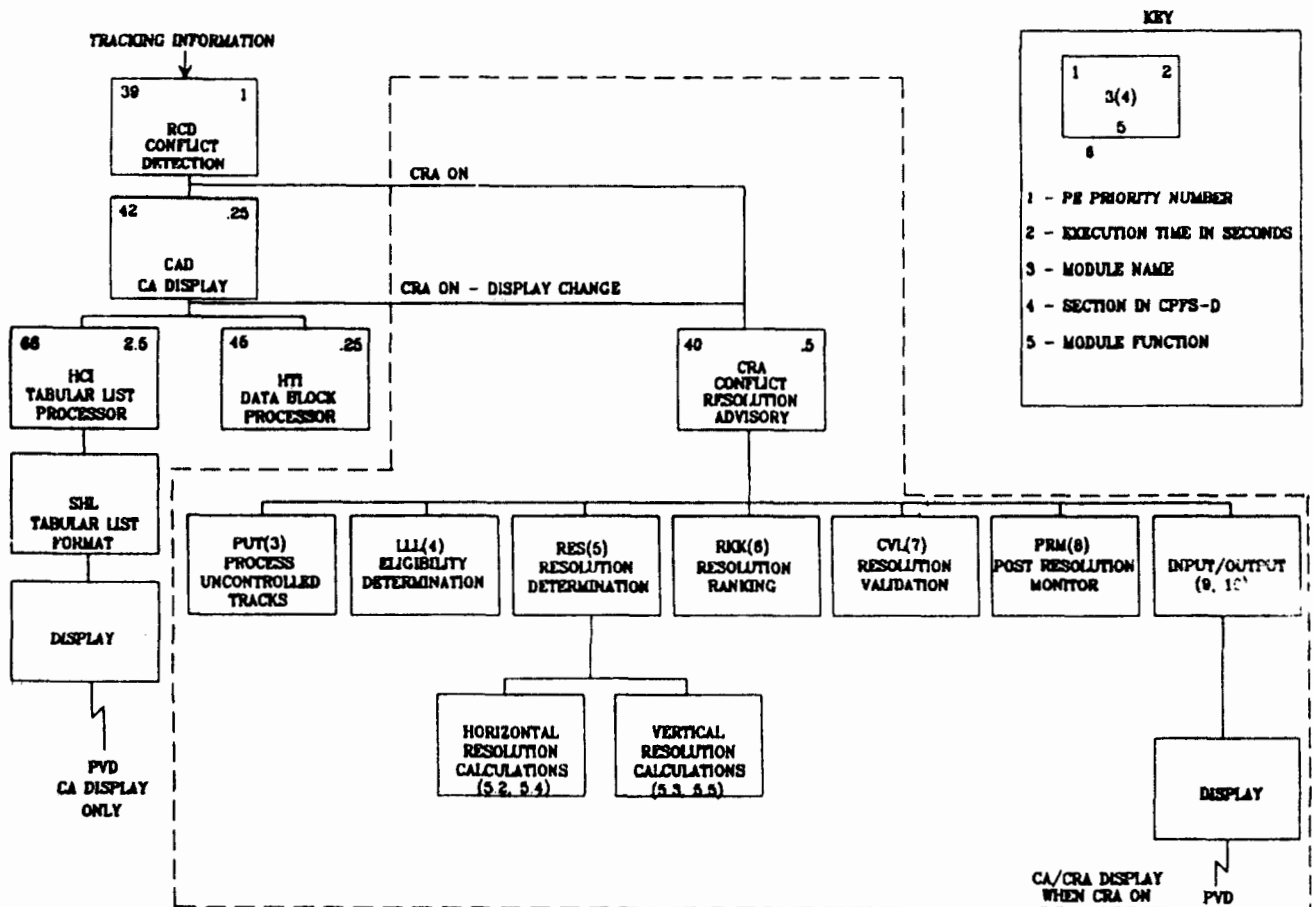
modified to designate CCD 12355 as the governing CRA requirements document. CCD 12355 is included in this order as appendix 1. The CRAU software has been rehosted from the 9020 system to the A4e0.1 and has been upleveled to the ATRDEV04 developmental baseline. The CRAE effort has completed the CRA Critical Design Review (CDR) and is currently coding the software.

23.-29. RESERVED.

## CHAPTER 3. PROJECT DESCRIPTION

30. FUNCTIONAL DESCRIPTION. The CRA functional processes are described in Figure 3-1, CRA Design Architecture. Since CRA acts as a subprogram to CA, CRA processing or display capabilities may be turned off without adversely affecting the operation of CA. For those potential conflicts which are detected by CA prior to the violation of separation standards, CRA will process CA and track data to determine a single validated resolution to be displayed to the controller. The following CRA functional modules are utilized to determine the resolution:

FIGURE 3-1. CRA DESIGN ARCHITECTURE



- a. Process Uncontrolled Tracks. The process uncontrolled tracks subroutine determines which uncontrolled tracks are eligible for CRA resolution and/or validation processing.
- b. Eligibility Determination. The eligibility determination module is responsible for building conflict configurations from established CA pairs and determining the type resolution (vertical or horizontal) which can be applied to each conflict pair member.
- c. Resolution Determination. The resolution determination module calculates horizontal and vertical resolutions for single and multiple pair conflicts. Resolution Determination also calculates the projected time in which half the horizontal maneuver or all of the vertical maneuver will be completed.
- d. Resolution Ranking. The resolution ranking subroutine calculates an aggregate score for each resolution based on criteria such as the resolution type (vertical or horizontal) and time criticality of the maneuver or maneuvers. The aggregate score is then used to determine the optimal resolution which will be sent to validation processing.
- e. Resolution Validation. The resolution validation module builds the neighborhood affected by the maneuvered aircraft and verifies that the action does not violate separation with other aircraft within the neighborhood or En Route Minimum Safe Altitude Warning areas. If the resolution does not meet the validation criteria, the next highest ranked resolution is subjected to validation processing.
- f. Post Resolution Monitor. The post resolution monitor subroutine checks for changes in the configuration status from scan to scan and determines if modifications to the display are necessary.
- g. Input/Output. The input/output module provides the supervisor with a means to modify the operational status of CRA and controls output processing for the CA/CRA tabular list. The output messages for the CA/CRA list are sent to the display channel to allow the tabular list to be displayed on the controller's Plan View Display (PVD). Figure 3-2, CA/CRA Tabular List, illustrates the modification to the current CA tabular list when CRA is operational. Example 1 indicates that aircraft PHR202 requires a right 30 degree maneuver. The turn will cause the aircraft to vector into sector 02's airspace. Example 2 illustrates a joint maneuver resolution which requires two aircraft to be maneuvered to solve the conflict. Aircraft USA208 is required to descend to 19K feet and aircraft PVR207 is required to level off from its descent to an altitude of 20K feet.

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FIGURE 3-2. CA/CRA TABULAR LIST

<u>Ex. 1</u>	PHR201	PHR202	02	01 <sup>1</sup>	<u>Ex. 2</u>	.USA208	PVR207	
	PHR201 <sup>2</sup>					J <sup>5</sup> USA208		↓190 <sup>6</sup> 03
	PHR202	R30 <sup>3</sup>		02 <sup>4</sup>		J PVR207		M200
<u>COLUMN</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>			
<u>Ex. 3</u>	.MHR101	MHR102				<u>Ex. 4</u>	.MVR108	MVR110
	.MHR102	MHR103					.MVR109	MVR110
	M <sup>7</sup>						.MVR444	MVR109
	MHR101						M	
	MHR102	L80					J MVR108	
	MHR103						J MVR110	↑240 12
							J MVR109	↓220
							J MVR444	

Key for shaded text:

- <sup>1</sup> Conflict Alert tabular list w/intersector notation (currently operational)
- <sup>2</sup> AID for CRA aircraft (CRA column 2)
- <sup>3</sup> Horizontal maneuver - right or left in degrees (CRA column 3)
- <sup>4</sup> Sector or facility to which CRA aircraft directed (CRA column 5)
- <sup>5</sup> Joint (2 maneuvers req.) or single resolution maneuver (CRA column 1)
- <sup>6</sup> Vertical maneuver - altitude for climb, descend, or maintain (CRA column 4)
- <sup>7</sup> Conflict Alert designator for multiple pair conflict

Note: Column spacings shown below Ex. 1

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31. PHYSICAL DESCRIPTION. The CRA function does not require the addition of any new hardware components.

32. SYSTEM REQUIREMENTS. CRA requires that the MCI/CAE program has been successfully implemented prior to the operational implementation of CRA. These modifications are required to reduce nuisance alerts which directly impact the processing of CRA. The development of these modifications has been completed by the contractor and will be incorporated in the A4e1.1 baseline for release in mid-1992. The contractor is currently using the ATRDEV04 baseline modified with the MCI/CAE software to support the development of CRAE software.

33. INTERFACES. CRA has no external interfaces.

34.-39. RESERVED.



## CHAPTER 4. PROJECT SCHEDULE AND STATUS

40. PROJECT SCHEDULES AND GENERAL STATUS. The CRA program relies on two related schedules for reporting and monitoring CRA activities.

a. NAS Program Statusing and Baseline Schedule. This baseline schedule tracks the CRA level 1 (AND-2) and level 2 (ANA-1) milestones for reports to higher level FAA management. The CRA schedule is reviewed bimonthly during the NAS Program Director Status Review (PDSR). The schedule is updated as milestones are completed or as changes become apparent. Procedures for changing the baseline schedule are described in NAS Project Statusing and Baseline Schedule Change Control Procedures. The current NAS Program Statusing and Baseline Schedule is found in appendix 2.

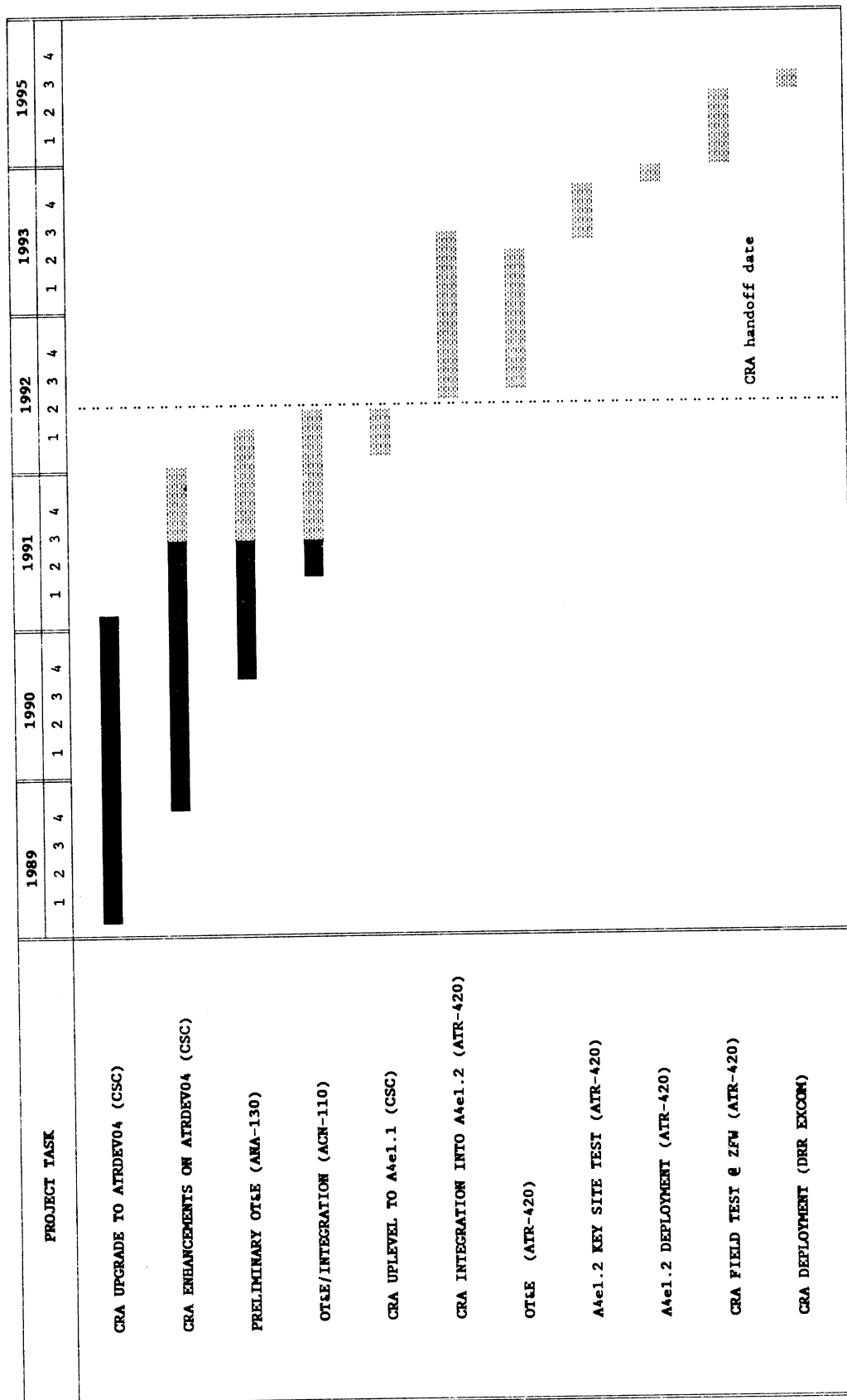
b. CRA Master Program Schedule. This schedule contains milestones that are of interest to the CRA project manager and supplements those reported on to the PDSR. This schedule is updated as required by the project manager. The current CRA Master Program Schedule is found in appendix 3.

41. MILESTONE SCHEDULE SUMMARY. The key milestones for the CRA development and implementation effort are provided in Figure 4-1, CRA Milestone Schedule. The National Automation Field Support Division, ATR-400, handoff date for the A4e1.2 HCS release (May 1992) is the driving factor behind the current schedule. All developmental and uplevel milestones are to be accomplished prior to this date for the CRA software to meet its assigned Capital Investment Plan date.

42. INTERDEPENDENCIES AND SEQUENCE. The CRA schedule is contingent upon two interdependencies. As noted in the paragraph 32, System Requirements, CRA is dependent on the implementation of the MCI/CAE program. This program has met its developmental milestones and will be included in the A4e1.1 baseline for implementation in mid-1992. The second interdependency is attributed to the timing of the CRAU effort. The CRAU software on the ATRDEV04 baseline must be completed before the CRAE CDR in order to prevent any schedule slips for coding of the CRAE requirements. The CRAU ATRDEV04 action has been completed. The CRA Master Program Schedule (appendix 3) illustrates the current timing of the these two efforts.

43.-49. RESERVED.

FIGURE 4-1. CRA MILESTONE SCHEDULE





## CHAPTER 5. PROJECT MANAGEMENT

50. PROJECT MANAGEMENT, GENERAL. The technical management of the CRA project is the responsibility of the Program Manager for En Route Automation/TMS, ANA-300. This organization manages the CRA project within guidelines provided by FAA policies, directives, and procedures. The ERSDS Contracting Officer's Technical Representative (COTR), ANA-130, is the focal point for all activities and is responsible for the day-to-day management of the project.

51. PROJECT CONTACTS. The personnel directly involved with the CRA project are listed in Table 5-1, Project Contacts.

TABLE 5-1. PROJECT CONTACTS

<u>Name</u>	<u>Telephone No.</u>	<u>Function</u>	<u>Organization</u>
Larry Reeves	202/267-8337	Project Engineer	En Route Automation/TMS Program, ANA-130
John Moore	202/646-5926	Asst. Project Engineer	System Engineering and Integration Contractor
Gary Mileski	202/267-9184	CRA Coordinator	En Route Branch, ATR-110
Harry Chasin	202/267-9443	CRA Coordinator	Automation Planning Branch, ATR-210
Mike Mullens	202/267-9369	CRA Coordinator	Air Traffic Systems Management Branch, ATM-110
Floyd Etherton	202/267-9332	CRA Coordinator	En Route Procedures Branch, ATP-130
Dick Pollock	202/366-1294	CRA Coordinator	Field Development Program, ATZ-100
Steve Anderson	202/366-7996	CRA Coordinator	Air Traffic Training Program, AHT-500
Rich Smith	609/482-6067	CRA Coordinator	En Route Field Support Branch, ATR-420
Gary Jones	609/484-6026	CRA Deployment	En Route Field Support Branch, ATR-420
Gary Ellison	609/484-5005	CRA Test Coordinator	Automation Software Branch, ACN-110
Kim Cardosi	FTS 837-2896	Human Factors Test	Transportation System Center, DTS-45
R. Raffensperger	202/646-8976	Configuration Audit	System Engineering and Integration Contractor
Marty Lupinetti	609/383-8110	Project Lead	Computer Sciences Corporation
Ron Tornese	609/272-4032	Technical Support	MITRE Corporation

52. PROJECT COORDINATION. The CRA Memorandum of Understanding (MOU) dated January 1991 addresses coordination issues which must be resolved for the CRA project to be developed and implemented. The specific CRA responsibilities of ANA-130 and other FAA organizations are also delineated in the CRA MOU.

a. Automation Engineering Division, ANA-100. ANA-130 provides matrix technical support to ANA-300 for the CRA project. The relationship between ANA-300 and ANA-130 is specifically defined in the Associate Program Manager for Engineering (APME) charter. Included in the role of ANA-130 is the responsibility to review and approve all products delivered and presented by the software development contractor. ANA-130 is the COTR and is responsible for coordinating activities during CRA software development, test, and integration. The System Engineering and Integration (SEI) contractor will support ANA-130 with the execution of these duties.

b. Program Manager for En Route Automation/TMS, ANA-300. ANA-300 is the program manager until completion of field implementation. The primary role of ANA-300 is to monitor the overall performance and control the CRA budget and schedule. ANA-300 is supported by two associate program managers to perform technical and test management. As APME, the Associate Program Manager for Engineering, En Route Automation/TMS Program, ANA-130, is the project's technical liaison and is responsible for day-to-day monitoring, coordination, and review activities. Test support for CRA is provided by the Automation Division, ACN-100, as the designated Associate Program Manager for Test (APMT). The APMT activities are based on a program directive between ANA-300 and ACN-100 which is reviewed yearly. Specific ANA-300 test responsibilities are defined in Order 1810.4A, FAA NAS Test and Evaluation Program.

c. System Plans and Programs Division, ATR-100. The En Route Branch, ATR-110, is responsible for coordinating with the Air Traffic Systems Management Branch, ATM-110, the En Route Procedures Branch, ATP-130, and the Automation Planning Branch, ATR-210, to ensure that a consensus is achieved on all CRA requirements. During the design phase, ATR-110 will be required to attend all design reviews and provide formal evaluation of the contractor's interpretation of design requirements. ATR-110 will coordinate with ATM-110 and ATP-130 to assist the Training Requirements Program, ATZ-100, with the identification of CRA training requirements. During preliminary CRA Operational Test and Evaluation (OT&E), ATR-110 will oversee the development of test objectives and execution of the tests. In addition, ATR-110 will be the primary interface between FAA headquarters and the designated key test site for the coordination of controller test teams and resolution of human resource issues.

d. Automation Software Policy and Planning Division, ATR-200. ATR-210 is responsible for ensuring that all requirements for the CRA function are clearly defined during the requirements phase of the project. ATR-210 will provide inputs to the CRA requirements case file and provide final approval. During the design phase, ATR-210 will be required to attend all design reviews and provide formal evaluation of the contractor's interpretation of design requirements. ATR-210 is also considered the primary air traffic interface at the FAA headquarters on performance and requirements issues.

e. National Automation Field Support Division, ATR-400. The En Route Field Support Branch, ATR-420, is responsible for the development of en route software releases. These include both the release that CSC will use for software development (modified ATRDEV04) and a later version that will include

the CRA release for operational use. ATR-420 is responsible for providing access to ACN-110 for contractor use of the ATRDEV04 baseline software on the Computer Support/Systems Development facility. ATR-420 is responsible for attending the test readiness review to be presented by CSC prior to the start of formal FAA testing. In addition, ATR-420 will observe the formal test and will review and approve the test results. ATR-420 will support CRA OT&E/integration and preliminary OT&E. ATR-420 is responsible for review and comment of the OT&E/integration Test Plan which will be prepared by ACN-110 prior to OT&E/integration. ATR-420 is responsible for observing the OT&E/integration tests. In support of preliminary OT&E, ATR-420 will provide resources to assist in the development of test scenarios and field test site adaptation at the FAA Technical Center. ATR-420 will be responsible to observe the tests and review the test results. ATR-420 will participate in requirements, design, and code reviews. In conjunction with primary responsibilities, ATR-420 will also review and comment on documentation changes. A formal Functional Configuration Audit/Physical Configuration Audit (FCA/PCA) will be held at the completion of CRAE development on the modified ATRDEV04 baseline. Prior to the FCA/PCA, ATR-420 will support the Configuration Management Branch, ASE-620, in developing an audit plan. ATR-420 will review and approve the plan. After successful completion of the FCA/PCA and upgrading the CRA software to the current operational baseline, ATR-420 will accept the CRA software for integration into the NAS HCS release designated by the Air Traffic Configuration Control Board.

f. Air Traffic Systems Management, Civil Operations Division, ATM-100. The primary role of ATM-110 with respect to CRA is to originate changes to operational requirements and develop policy for operational implementation. ATM-110 conducts the functional verification to ensure that the function meets operational requirements and oversees the operational evaluation of CRA software during key site testing. In support of the key site testing, ATM-110 is responsible for selecting the operational test site.

g. Air Traffic Procedures Division, ATP-100. ATP-130 will develop procedures required for CRA operational implementation; participate as a member of the ATR-200 Configuration Control Board; coordinate, along with ATM-110 and ATR-110, training requirements for use of the CRA automation aids with ATZ-100; and provide briefings to the Office of Labor and Employee Relations, ALR-1, on enhancements that require air traffic union notification.

h. Configuration Management and Engineering Support Division, ASE-600. Upon completion of the contractor's internal FCA/PCA, ASE-620 will conduct an FCA/PCA which will be approved by ATR-420 and managed by both ANA-130 and ATR-420. ASE-620 will write an FCA/PCA Plan which will be reviewed and approved by ANA-130 and ATR-420. The SEI will support the CRA FCA/PCA as part of its responsibilities to ASE-620.

i. Automation Division, ACN-100. As the designated APMT, ACN-110's roles and responsibilities are defined in the ANA-300/ACN-100 program directive and Order 1810.4A. The primary function of ACN-110 is to act as an agent for ANA-300 to oversee the test and evaluation program. As lead CRA test organization, ACN-110 will be responsible for developing an approved CRA Master Test Plan which identifies all facets of testing associated with the program. ACN-110 will be responsible for OT&E/integration and support of

preliminary OT&E. For OT&E/integration, ACN-110 will develop and submit an Integration Test Plan to ANA-130 and ATR-420 for review and comment. Approval of the document will be provided by ANA-130. ACN-110 will be responsible for conducting OT&E/integration and providing test results in the form of a test report to ANA-130 and ATR-420. ACN-110 will assist ANA-130 in the coordination of preliminary CRA OT&E prior to handoff of the software to ATR-420. ACN-110 will support the development of test objectives and plans, acquisition of software simulation support facilities, execution of the test, and development of the test reports. ACN-110 will also be responsible for tracking and ensuring the resolution of program trouble reports resulting from the CRAU and CRAE test efforts.

j. Transportation System Center (TSC), DTS-45. DTS-45 is responsible for supporting the Human Factors Test and preliminary OT&E. DTS-45 will develop test plans and procedures, perform analysis of test data, and provide test results in a final test report.

53. PROJECT RESPONSIBILITY MATRIX. Table 5-2, Project Responsibility Matrix, is used to identify the major program activities associated with implementation and the responsible organizations.

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TABLE 5-2. PROJECT RESPONSIBILITY MATRIX

<u>Activity</u>	<u>ANA-130</u>	<u>ATR-420</u>	<u>ATM-110</u>	<u>ATP-130</u>	<u>ACN-110</u>	<u>ATR-110</u>	<u>ATR-210</u>	<u>ASE-620</u>	<u>TSC</u>
Human Factors Test	R	S/R	R	R	S/R	R	R		L
Preliminary OT&E	L	S/W	R	R	S/R	R	R		S/W
OT&E/Integration	R	R	R	R	L/W	R	R	R	
Configuration Audit	S	S/W	R	R	S	R	R	L	
OT&E		L/W	R		S		R		
Deployment	S	L	S						
Maintenance	S	L			S				

Key: L Lead organization  
 S Supports lead organization activities  
 W Writes plans and results  
 R Review plans and results

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54. PROJECT MANAGERIAL COMMUNICATIONS. Meetings for the resolution of technical issues associated to the CRA program are scheduled as needed. Historically, technical interchange meetings have been held approximately every four to six weeks. These meetings generally include air traffic representation, the program office, and developmental and technical support

contractors. Administrative and contractual issues associated with the CRA program and other ERSDS programs are discussed during the ERSDS monthly management meeting. Meeting attendance normally includes ANA-130, CSC, ATR-420, and ACN-110. Status of the project is reported bimonthly to ANA-1 in the PDSR. The report consists of the current program milestone chart and a narrative to describe lower level accomplishments, program concerns and issues, and action plans to resolve those concerns and issues. Four times a year a formal program briefing is provided by ANA-130 to ANA-300 on the progress and status of the CRA development effort. The briefing includes the technical and financial status of the CRA project.

55. IMPLEMENTATION STAFFING. Additional staffing is required at the first CRA key site to support field testing of the function. Prior to allowing the remaining 19 ARTCC's to go operational, air traffic requires that the CRA function be operationally tested at the Fort Worth ARTCC for a period of approximately 6 months. Contractor support is required to validate the operation of CRA through the evaluation of data reduction and controller surveys. The program office plans to fund a 6 man-month effort (one person) to provide this resource.

56. PLANS AND REPORTS. The CRA program is required to meet the guidelines established in the Deployment Readiness Review (DRR) process. In order to implement the function, two DRR reports are required. These reports are completed and delivered to the Executive Committee (EXCOM) prior to handoff to ATR-400 and prior to NAS-wide Operational Readiness Demonstration (ORD) of the function. Favorable EXCOM decisions are required to continue the implementation of the function.

57. APPLICABLE DOCUMENTS. The following is a listing of CRA project-related documents. They provide information, policy, and directives applicable to CRA implementation. Any conflicts between these and other regional guidance should be referred to the CRA Project Manager for resolution.

a. FAA Standards.

FAA-STD-024a Preparation of Test and Evaluation Documentation

FAA-STD-036 Preparation of Project Implementation Plans

b. FAA Orders.

Order 1320.1C FAA Directives System

Order 1810.4A FAA NAS Test and Evaluation Program

Order 1800.58 National Airspace Integrated Logistics Support Policy

c. CRA Documentation.

CCD 12355      Conflict Resolution Advisory Software Development,  
June 1990

CRA MOU      CRA Memorandum of Understanding, January 1991

CRA MTP      CRA Master Test Plan, February 1991

58.-59. RESERVED.

## CHAPTER 6. PROJECT FUNDING

60. PROJECT FUNDING STATUS. The CRA project is funded with FAA Facilities and Equipment appropriations. Funds have been allocated to CSC under the ERSDS contract, DTFA01-89-C-00017, through fiscal year 1991. Fiscal year funding in 1992 and beyond has been requested to complete implementation. The COTR for this contract is Larry Reeves, ANA-134. The ERSDS contract will be modified to include the CRA upleveling task from the ATRDEV04 to the A4e1.1 baseline. The uplevel effort is required by ATR-420 prior to the software handoff date in May 1992. The contract modification will be funded with fiscal year 1992 dollars to accommodate a start work date of February 1991.

61.-69. RESERVED.





## CHAPTER 7. DEPLOYMENT

70. GENERAL DEPLOYMENT ASPECTS. Because the CRA function will be part of a national HCS release, the software will be subjected to procedures and guidelines used for incorporating new enhancements into the latest field baseline. One exception to this process is the air traffic requirement to perform a field evaluation of CRA prior to implementing the function at all 20 ARTCC's. This exception requires a 6-month evaluation period of CRA after the A4e1.2 release has achieved ORD at the Fort Worth ARTCC (ZFW). The ORD will be approved with the CRA function being allowed to process all detected conflicts but the resulting CRA DISPLAY INHIBITED.

a. Deployment Process. The ATRDEV04 CRA software will be completed by the contractor in January 1992 and uplevelled to the A4e1.1 baseline for handoff to ATR-420 in May 1992. ACN-110 will perform OT&E/integration of the ATRDEV04 CRA software and will provide preliminary results by April 1992 and final results by the May 1992 software handoff date. ATR-420, under the direction of ASM-400, will then perform formal OT&E/shakedown testing as the function is incorporated into the A4e1.2 release. Key site testing for the A4e1.2 baseline with the CRA DISPLAY INHIBITED is currently scheduled for July 1993 with the resulting ORD at all 20 ARTCC's occurring by December 1993. At that time, ZFW will display the CRA tabular list and will perform extensive operational evaluation of the CRA function for approximately 6 months. Assuming the function works properly and only minor software modifications are required, the remaining 19 sites will be allowed to utilize the CRA display in July 1994. This schedule (see appendix 2) allows all ARTCC's to utilize the new function a few months prior to the release of A4e1.3.

b. Deployment Readiness Review. The DRR process is being invoked during the development and implementation of the CRA software. The initial DRR team meeting was held in December 1990 to review the DRR checklist. The checklist is reviewed by team members monthly in order to resolve outstanding action items. The current DRR procedures require the resolution of all noted DRR issues prior to the ATR-420 handoff and the decision to allow all ARTCC's to operationally use the CRA function. Based on these requirements, DRR reports will be delivered and subsequent DRR EXCOM decisions will be made for the project in May 1992 and July 1994.

71. SITE PREPARATION. There are no special site preparations required to implement the CRA function.

72. DELIVERY. CRA software will be delivered to the field as part of the A4e1.2 baseline. As explained in paragraph 70, the schedule illustrated in table 7-1 will be used for delivery of A4e1.2 and the CRA function.

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TABLE 7-1. CRA IMPLEMENTATION SCHEDULE

A4e1.2 Key Site Test (CRA Display Off)	Jul 1993
First A4e1.2 ORD (CRA Display Off)	Nov 1993
Last A4e1.2 ORD (CRA Display Off)	Dec 1993
Start CRA Evaluation (ZFW)	Dec 1993
Finish CRA Evaluation (ZFW)	Jul 1994
CRA DRR EXCOM	Jul 1994
CRA Operational at all ARTCC's	Jul 1994

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73. INSTALLATION PLAN. The A4e1.2 baseline software will be installed at all sites using standard air traffic installation procedures for new releases. These procedures include the incorporation of new CRA parameters to the site adaptation data base at each facility.

74.-79. RESERVED.

## CHAPTER 8. VERIFICATION

80. FACTORY VERIFICATION. Contractor developed software for CRA will be fully tested by CSC and MITRE at the FAA Technical Center prior to handoff to ATR-420. CSC will perform formal acceptance tests to verify that all CRA requirements in CCD 12355 have been met. MITRE will perform independent design verification tests to ensure that the developed software reflects the proper interpretation of these air traffic requirements. Both tests and test results will be accessible to ANA-300, ATR-210, and ATR-420 for verification.

81. CHECKOUT. Verification that the CRA function is operating properly in the field will be accomplished during the 6-month operational evaluation at ZFW.

82. CONTRACTOR INTEGRATION TESTING. As part of Developmental Test and Evaluation (DT&E), CSC will perform regression testing to validate the integrity of ATRDEV04 HCS functions with CRA included. In addition, CSC will execute performance measurement tests to quantify the impact on HCS with the addition of the CRA software. The performance tests are based on established air traffic workload scenarios.

83. CONTRACTOR ACCEPTANCE INSPECTION (CAI). CAI will be performed during the FCA/PCA of the CRA software and documentation in January 1992. All issues and action items resulting from the audit must be resolved prior to the software being delivered to ATR-420 in May 1992.

84. FAA INTEGRATION TESTING. Integration testing of the CRA function will be performed by ACN-110 and ATR-420. ACN-110 will be responsible for performing OT&E/integration of the ATRDEV04 CRA software prior to the May 1992 handoff date. After the CRA software has been upleveled to the A4el.1 baseline, ATR-420 will incorporate CRA into the developmental A4el.2 baseline. The software will go through a series of operational and integration tests during this process to ensure that the system is not degraded when combining CRA with new HCS enhancements. These tests will be completed prior to the July 1993 A4el.2 key site test.

85. SHAKEDOWN AND CHANGEOVER. The CRA function will be subjected to an extensive OT&E effort. A series of tests will be performed at the FAA Technical Center utilizing ZFW air traffic controllers in simulated ZFW airspace. Three phases of OT&E have been identified.

a. Phase 1: Human Factors. A 2-week test was performed in April 1991 to identify the range of controller reaction time to resolve conflicts with CRA. Since the test utilized the ATRDEV04 CRAU software rather than the enhanced CRAE software, no assessment was provided of the requirements established in CCD 12355.

b. Phase 2: Preliminary OT&E. A 4-week test will be performed in January 1992 utilizing the CRAE software. This test will provide the first feedback for the enhanced ATRDEV04 CRA software. Deficiencies identified during this test will be provided to the contractor for incorporation during the upleveling of the software to the A4el.1 baseline. The test also provides a foundation for identifying future enhancements to the function.

c. Phase 3: OT&E. A series of 2-week tests will be performed by ATR-420 from July 1992 and May 1993. After handoff of the CRA software to ATR-420 on the A4el.1 baseline, ATR-420 will perform formal OT&E of the function to identify deficiencies not identified during the phase 1 and phase 2 tests. Identified deficiencies will be resolved during the integration process prior to key site testing of the A4el.2 package in July 1993. Upon completion of these tests at the FAA Technical Center and the A4el.2 key site test, the CRA function will be subjected to the 6-month operational evaluation at ZFW described in paragraph 70.

86. JOINT ACCEPTANCE TEST (JAI). JAI will not be performed due to the CRA function being included as part of a national air traffic software release.

87.-89. RESERVED.

## CHAPTER 9. INTEGRATED LOGISTICS SUPPORT

90. MAINTENANCE CONCEPT. Upon successful completion of the configuration audit, the contractor delivers the developed software to the Government and ATR-420 accepts maintenance responsibilities. ATR-420 will continue maintenance support through the life cycle of the program.

91. TRAINING. CRA training will be provided for air traffic controllers and air traffic software personnel. ATZ-100 will develop a CRA training proposal which serves as the basis for training package development by the Air Traffic Training Program, AHT-500. The controller training package will be delivered to the FAA Academy, AAC-930, in October 1993 and the CRA key site, ZFW, in November 1993. Upon verification of the training package content during CRA key site testing, other ARTCC's will receive their training materials 30 days prior to deployment of the function (April 1994). Air traffic software training will be provided via the CRA Adaptation Users' Guide. The document will be provided to the A4el.2 key site in June 1993 and 30 days prior to A4el.2 ORD at the remaining sites. Although the CRA display will be inhibited at that time, the function will continue to process and therefore requires adaptation parameters to be in place.

92. SUPPORT TOOLS AND TEST EQUIPMENT. Implementation of the CRA function within the A4el.2 release does not require the use of any special support tools.

93. SUPPLY SUPPORT. Supply support is not required for the CRA program.

94. VENDOR DATA AND TECHNICAL MANUALS. The technical description of the CRA function is found in the contractor developed CRA Computer Program Functional Specification. This document will become part of the NAS-MD series which is made available to technical support personnel at the FAA Technical Center and ARTCC's. The CRA Adaptation Users' Guide will also be provided for modification of site specific data with new CRA parameters.

95. EQUIPMENT REMOVAL. The implementation of CRA does not require the modification or removal of existing hardware.

96. FACILITIES. Impacts to the ARTCC facilities include modifications to site adaptation data bases and air traffic CRA training prior to operational deployment. These requirements are considered standard with the implementation of a new software field release.

97.-99. RESERVED.



APPENDIX 1. CCD 12355

NAS CONFIGURATION CONTROL DECISION		
1. TO: (NCP/CCD WEEKLY PACKAGE DISTRIBUTION)		
2. NCP TITLE  12355 - CONFLICT RESOLUTION ADVISORY SOFTWARE DEVELOPMENT		3. CCD NUMBER  N/12355
4. CASE FILE NUMBER  AP310-CPF-004	5. SITE LOCATION  NATIONAL	6. END ITEM NUMBER  CPF
7. ACTION DIRECTED (in accordance with 1104.2, Change 128)  Accomplish the actions described under NCP 12355 dated December 7, 1989.  <u>ACTION:</u> ATR-200 - Coordinate and schedule the implementation of this approved change.  - Implement in future system version.  - Update NAS-MD-310, 311, 314, 321, 326 and 327 as required to reflect the change and provide ASE-621 with a copy.  ASE-620 - Update CM/STAT to reflect the status of this change.  ASE-621 - Update DOCCON upon receipt of the documentation.		
8. REMARKS		
9. DECISION  <input checked="" type="checkbox"/> Approved <input type="checkbox"/> Disapproved	10. DATE  6/14/90	11. SIGNATURE AND TITLE  _____ Chairman, Auto. Software Policy & Plan. Div. (ATR-200)
12. EXPLANATION OF NCP DISAPPROVAL		

8/28/91

NAS CHANGE PROPOSAL (Please Type or Print Neatly)		FOR CW USE	Date Received	NCP Number	Page 1 of 1
1. Prescreening Office <input type="checkbox"/> APM-150 <input type="checkbox"/> ATR-100 <input type="checkbox"/> APM-180 <input checked="" type="checkbox"/> ATR-200 <input type="checkbox"/> _____	2. End Item Number	3. Scope of Change <input type="checkbox"/> Local <input checked="" type="checkbox"/> National <input type="checkbox"/> Test <input type="checkbox"/> NAS Plan		4. Case File Number AP310-CPF-004	
5. Program Element <input checked="" type="checkbox"/> En Route <input type="checkbox"/> Flight Service <input type="checkbox"/> Interfacility Comm <input type="checkbox"/> Terminal <input type="checkbox"/> Ground-to-Air <input type="checkbox"/> Maint & Ops Support <input type="checkbox"/> Other _____		6. Life-Cycle Phase <input type="checkbox"/> Requirements Determination <input type="checkbox"/> Subsystem Acquisition <input checked="" type="checkbox"/> Operational		7. Priority <input checked="" type="checkbox"/> Normal <input type="checkbox"/> Time Critical <input type="checkbox"/> Urgent	
8. Supplemental Change Form <input type="checkbox"/> RCP <input type="checkbox"/> ECR <input type="checkbox"/> Emp. Sugg. <input type="checkbox"/> _____	9. Supplemental Change Number	10. Baseline Document Type <input checked="" type="checkbox"/> CPFS <input type="checkbox"/> IRD/ICD <input type="checkbox"/> T.I. <input type="checkbox"/> EEM/PEM <input type="checkbox"/> Spec. <input type="checkbox"/> Maint. Handbk. <input type="checkbox"/> Dwg. <input type="checkbox"/> _____		11. Baseline Document Number NAS-MD-310,311, 314,321,326,327	
12. Originator Allen Beard	13. Originator's Organization AAP-312	14. Telephone Number FTS 267-8342		15. Date Initiated Oct. 24, 1989	
16. Facility/Identifier (FACID) PAA HQ	17. Facility Code	18. FA Type Number		19. Serial Number	
20. Title (as descriptive as possible, and if applicable, include location and runway number).  Conflict Resolution Advisory Software Development					
21. Description: (a) Identification of problem, (b) proposed change, (c) interface impact, (d) cost, (e) benefits, (f) schedule, (g) justification of time critical/urgent.  This National Airspace System (NAS) change proposal is provided to define revisions and enhancements to functional requirements established for the Conflict Resolution Advisory (CRA) function as defined in NAS Plan Project 1-09, Configuration Control Decision (CCD) 9794, and Air Traffic CRA memorandum from ATR-101 to AAP-300 dated 31 August 1989. Since the ATR-101 memorandum changes some requirements in CCD 9794, this case file, in conjunction with case file AP310-CPF-002 (Mode C Intruder/Conflict Alert Enhancements requirements), incorporates those requirements maintained from CCD 9794 and new Air Traffic requirements established in the memorandum. Approval of this NAS Change Proposal (NCP) and case file AP310-CPF-002 establishes documents which supersede CCD 9794 and authorize acquisition of software design/development. A later NCP will be submitted to authorize implementation of this software in the operational system.  a. <u>Problem</u> : Acquisition of contractor services in software development is necessary to incorporate enhancements and revisions to Host Computer System (HCS) CRA Upgrade baseline program. The HCS CRA Upgrade baseline was developed from the CRA prototype baselined in the 9020 release A3d2.12 and maintains the identical functional capability.  b. <u>Proposed Change</u> : The enclosed case file AP310-CPF-004 describes the changes necessary to the functional requirements for CRA established in MITRE report MTR80W137. Approval of these changes is necessary for the release of implementable CRA software.					
(attach additional sheets if necessary)					
22. Title of Originating Office Manager Acting Mgr. En Route Auto. Branch, AAP-310		Signature <i>Delois K. Smith</i>		Date 11/3/90	



- c. Interface Impact: None.
- d. Cost: An estimated 18,000 additional lines of code will be required beyond the existing CRA Upgrade baseline.
- e. Benefit: Reduced sector controller workload and improved safety of flight.
- f. Schedule: The CRA software will be released in an HCS baseline to be designated by ATR-400.

Attachment: Case File AP310-CPF-004

CONFLICT RESOLUTION ADVISORY (CRA) FUNCTION ENHANCEMENT  
TO THE NATIONAL AIRSPACE SYSTEM EN ROUTE PROGRAM

1.0 Description of Problem

- 1.1 The present National Airspace System (NAS) en route software (Host Computer System (HCS) A4e0.1) provides automation aids to detect and notify the controller of actual or potential violations of separation thresholds. The software which performs this function is Conflict Alert. Conflict Alert will search for potential separation violations and actual separation violations between two Instrument Flight Rules (IFR) aircraft and between IFR and tracked Visual Flight Rules (VFR) aircraft. The Mode C Intruder (MCI) function provides the track data on untracked Mode C reporting aircraft to Conflict Alert.
- 1.2 Although Conflict Alert provides automatic controller notification of detected conflicts, there is currently no automation aid to assist the controller in resolving the potential separation violation. In situations of heavy traffic, complex traffic patterns, or multi-aircraft conflicts, the notification of an impending separation violation within two minutes may not afford the radar controller sufficient time to formulate a plan to resolve the situation and to coordinate that plan with the aircraft of concern.

2.0 Description of Change

- 2.1 Functional software based in the 9020 has been delivered to the FAA as a proof of concept. This software package was based upon the functional requirements defined in "En Route Conflict Resolution Advisories: Functional Design Specification", MTR80W137, April 15, 1981. The functional enhancements described in this case file are changes/modifications to the functional requirements defined in MTR80W137. Appendix A is a reference list of all the appropriate documentation for the CRA prototype and upgrade software.
- 2.2 This case file describes the necessary improvements to the Host en route software which will provide automation aids to assist the radar controller in resolving conflicts detected by Conflict Alert. The CRA function will be called on by the Conflict Alert function to provide resolutions to the controller.
- 2.3 Since the conflicts detected by Conflict Alert will drive the Conflict Resolution Advisory function, it is desirable to improve the performance of Conflict Alert. Improved performance of Conflict Alert will be achieved if the number of nuisance alerts

are decreased and the warning time provided for valid alerts is increased. These two goals will be accomplished by providing improvements to the NAS tracking and Conflict Alert functions. These required improvements are noted in case file AP310-CPF-002.

### 3.0 Implementation

- 3.1 The Conflict Resolution Advisory program will be implemented in two packages. The first package will consist of modifications to tracking and Conflict Alert functions in the existing software (case file AP310-CPF-002). These enhancements are requested to enable CRA to function properly, but are beneficial of themselves by improving the tracking and Conflict Alert algorithms.
- 3.2 The second package, Conflict Resolution Advisory, will be released to the field in two phases. Phase 1 will consist of the requirements listed in this case file and phase 2 CRA will consider for incorporation those requirements listed in Appendix B. A new case file will be written and approved prior to the development of phase 2 CRA software. The phased implementation approach is necessary due to the complexity resulting from numerous enhancements to the CRA prototype software.
- 3.3 The CRA phase 1 software will serve as the baseline for Conflict Resolution Advisory function. The delivered software package will provide Air Traffic Services with the capability of turning the CRA function completely on or off without interfering with the operation of Conflict Alert.

### 4.0 Conflict Resolution Advisory Requirements

The following are the requirements necessary for implementation of the CRA function. As previously addressed, the required improvements to the existing NAS software in the areas of NAS Tracking, Mode C Intruder Tracking, and Conflict Alert are delineated in case file AP310-CPF-002.

- 4.1 The en route Conflict Resolution Advisory function will provide the controller with advisories to alter flight trajectories of those aircraft predicted by the Conflict Alert function (including MCI alerts) to violate separation standards. Two types of resolutions will be considered for CRA: (1) single maneuver resolutions which alter the path of one aircraft and (2) joint maneuver resolutions which alter the path of two of the aircraft. The system shall have the capability of displaying one resolution which is selected from other candidates utilizing the process outlined in paragraph 4.10. To the extent possible, the resolution should take into account flight intent and propose resolutions which minimize departure from intent.

- 4.2 A conflict-free path is one which maintains the minimum horizontal or vertical en route separation prescribed in FAA Order 7110.65F (dated September 21, 1989 with changes 1, 2, and 3) from all aircraft and is free from encounters with protected airspace as defined by the En Route Minimum Safe Altitude Warning (E-MSAW) function. The CRA function will use parameters rather than fixed values for separation criteria to accommodate any future changes to FAA Order 7110.65F.
- 4.3 CRA will not provide a resolution for Conflict Alerts in which (1) track control for the conflict aircraft does not reside in one facility and (2) two or more facilities are involved. A no resolution message will be generated as part of the Conflict Alert/CRA tabular list when these conditions mutually exist.
- 4.4 Distribution of messages and displays should be such as to minimize coordination time among controllers affected by intrafacility advisories.
- 4.5 Since the controller does not provide separation between VFR aircraft and IFR aircraft, Air Traffic does not want the program to provide a resolution between an MCI aircraft and an IFR aircraft unless (1) the MCI aircraft can be correlated with a flight plan in the NAS data base or (2) is located in Positive Controlled Airspace (PCA). The primary purpose of the MCI alert is to permit the controller to provide a safety advisory to the controlled aircraft and then evaluate the situation to determine if further action is required. In the case where the track in conflict drops below PCA, continue to display the resolution if the track was eligible for CRA on the previous scan.
- 4.6 When no CRA resolution can be generated, the controller will be alerted via the tabular list that no CRA resolution will be displayed and the reason why the resolution is not available. Examples of when no resolutions are available include, but are not limited to, pop-up conflicts and certain geometries of multiple aircraft which provide little or no warning to separation violation.
- 4.7 The resolution displayed to the controller should maneuver the fewest possible number of aircraft involved in a detected conflict. In no case will a strategy include a maneuver for an aircraft which may be unable to receive or comply with a maneuver (e.g., an MCI or an aircraft whose beacon code indicates a radio failure, hijack, or an emergency). The Conflict Resolution Advisory function will be capable of resolving multiple-aircraft conflicts involving up to a maximum of four aircraft and three conflict pairs.

- 4.8 All resolutions considered for display to the controller need not involve maneuvers in the same dimension (horizontal or vertical). A single maneuver resolution may consider both horizontal and vertical resolutions for one aircraft. A joint maneuver resolution may consider a horizontal maneuver for one aircraft and a vertical maneuver for the other.
- 4.9 When more than one resolution is capable of independently resolving the same conflict, the candidate resolutions will be ranked in priority order. Factors considered in determining a resolution's priority ranking will include, but not be limited to the following which are listed in the order of importance:
- 1) Consistency with preceding displayed strategies.
  - 2) The time required to complete the maneuver versus the time to loss of separation.
  - 3) Degree of deviation from intended flight path.
  - 4) Number of aircraft maneuvered.
- 4.10 Resolution strategies will be devised which prevent the violation of separation standards for detected conflicts. These strategies will account for an expected delay between the time necessary to calculate the resolution and execution of that strategy by the aircraft of concern. Separate time parameters will be used for horizontal and vertical resolutions respectively.
- 4.11 The resolution strategies in the horizontal dimension will consist of heading changes. Speed reductions and aircraft accelerations will not be used as potential CRA resolutions based on non-effectiveness within the warning time provided by Conflict Alert.
- 4.12 The resolution strategies in the vertical dimension will consist of an altitude level which must be achieved. The desired altitude level may be achieved by terminating an existing transition or by initiating a transition from level flight. Aircraft types listed in the Aircraft Characteristic (ACHR) Record in the site specific adaptation database will be used when determining this type of resolution. A climb maneuver will be considered the least desirable of the four possible maneuvers displayed to the controller.
- 4.13 After the first scan of displaying a resolution, it is desirable to continue the same resolution on subsequent scans. The software will continue with the same or similar validated resolution over subsequent scans until the conflict is resolved or the resolution is no longer valid. A similar validated resolution is one that maintains the same maneuver direction yet the magnitude of the maneuver changes slightly.

- 4.14 Messages and displays conveying resolution information must be easily readable and conform to (or be strongly suggestive of) conventional controller language. The current CRA prototype has the capability to display resolutions graphically as well as in tabular form. Evaluation of the CRA prototype during testing resulted in the requirement to provide CRA resolutions in the tabular display only.
- 4.15 When the controller is presented with multiple unrelated conflicts, the messages and displays for each conflict will be presented so that the resolution will be clearly and easily associated with the appropriate conflict. The tabular display of CRA resolutions will not conflict with the display of any information necessary for the control of air traffic.
- 4.16 Potential resolution strategies will be checked against the projected paths of neighboring aircraft to determine if they will provide a conflict-free path. The selection of the neighboring aircraft against which the potential resolution advisories are checked must be done in an efficient manner. This can be done by eliminating non-neighboring aircraft through one or more filters. Aircraft which are too far from the subject conflict to be considered neighbors should be immediately eliminated and should not be subjected to any additional filters. Those aircraft which are potential neighbors should be submitted to one or more filtering schemes to either eliminate them from further consideration or submit them to a detailed trajectory check against the potential resolutions. Aircraft which are eligible for Conflict Alert processing will be eligible for consideration as potential neighbors.
- 4.17 All CRA resolutions will be validated against E-MSAW to ensure the displayed resolutions do not direct aircraft into E-MSAW airspace. An enhancement to the CRA prototype software will be provided to increase the accuracy of this validation process.
- 4.18 CRA will provide an additional check on the quality of an altitude track before vertical resolutions are allowed. This change to the current CRA prototype will require that a validated Mode C report is received within ZCST (nominally two) scans prior to use of a vertical resolution. Non-Mode C aircraft with assigned and reported altitudes will also be eligible for vertical resolutions.
- 4.19 Dynamically Simulated (DYSIM) tracks in conflict with other DYSIM tracks will be eligible for CRA resolutions. This will facilitate testing and training of the CRA function.

CCD 12355 APPENDIX A: DOCUMENTATION FOR CRA UPGRADE  
AND PROTOTYPE SOFTWARE

<u>COMDEX NUMBER</u>	<u>DOCUMENT TITLE</u>
CSC/TM-82/6213	Final CPFS for CRA (Rev 2)
CSC/TM-83/6007	Final CRA DART User's Guide
CSC/TM-83/6127	Final DART SOD
CSC/TM-83/6011	QA Test Report for CRA ACES
CSC/TM-84/6060	Report on the Integration of ERM-II, CRA, MCI
CSC/TM-84/6121	Final DART QAT Report for CRA
CSC/TM-84/6126	QA Test Report for CRA
CSC/TM-84/6127	Final CRA SDD
CSC/TM-85/6011	Preliminary Program Design Specification for the Integration of Mode C Intruder/Conflict Resolution Advisories
CSC/TM-84/6125	MCI/CRA Design Analysis Report
CSC/TM-84/6140	CPFS for Integration of MCI/CRA
CSC/TM-85/6029	Task 3, Phase II Conflict Alert Performance Improvements (CPFS)
CSC/TM-85/6033	Design Analysis Report (DAR) for Conflict Alert Performance Improvements
CSC/TM-85/6062	Quality Assurance Test Specification for Conflict Alert Enhancements (Task 3, Phase III) Rev 1
CSC/TM-85/6077	Program Design Document for Conflict Alert Performance Improvements (Task 3, Phase III) Rev 1 (change pages)
CSC/TM-85/6096	QA Test Procedure for Conflict Alert Performance Improvements (Task 3, Phase III) Rev 1
CSC/TM-83/6085	Data Analysis and Reduction Tool (DART) Test Specification/Procedure for CRA (Rev 1)
CSC/TM-83/6032	Acceptance Test Plan for Conflict Configuration Generator Test Tool (Rev 2)

CSC/TM-82/6122	Adaptation Controlled Environment System (ACES) Test Specification/Procedure for CRA (Rev 1)
CSC/TM-84/6127	CRA Subsystem Data Design (SDD) (Rev 1)
CSC/SD-89/6139	Software Test Plan (STP) for CRAU
CSC/TM-83/6014	Quality Assurance Test Specification/Procedure for CRAU (Rev 2)
CSC/TM-83/6055	Program Design Specification for CRAU
CSC/SD-89/6159	Compool Table Design Specification (CTDS) (Rev 2)



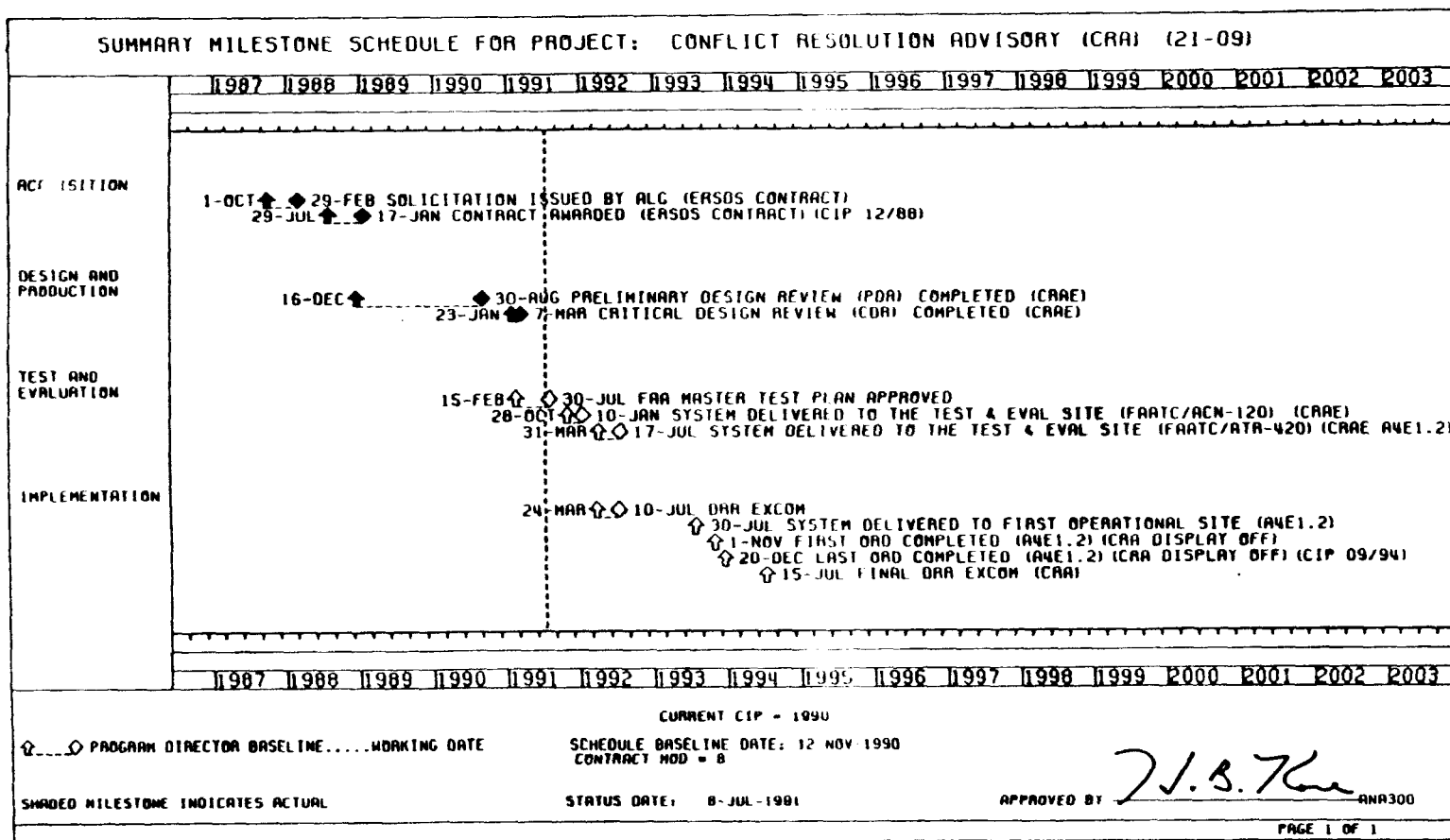
CCD 12355 APPENDIX B: PROPOSED ENHANCEMENTS TO  
THE PHASE 2 CRA SOFTWARE RELEASE

The purpose of this appendix is to document those requirements that should be considered for incorporation into the phase 2 CRA release. Due to the complexity associated with the CRA function, a decision was made by the Automation Engineering Division, ANA-100, to defer the following requirements to a later development effort. Since a new case file will be written to define the phase 2 CRA function, these delineated requirements will be subject to validation prior to development of an enhanced package.

1. When there is more than one en route facility involved in a conflict (i.e. one track handed off to another en route facility), each facility's CRA maneuver shall be compatible with possible CRA maneuvers being initiated by the other facility. Thus, each resolution, or any combination of resolutions, shall result in not less than the separation prescribed in paragraph 4.1 of case file AP310-CPF-004.
2. The Conflict Resolution Advisory function will be capable of resolving multiple-aircraft conflicts involving up to a maximum of five aircraft and four conflict pairs.
3. When a joint maneuver resolution is displayed to the controller for a conflict configuration, the maneuvers will be presented in priority order. The priorities shall be established using the ratios: 1) time to complete the maneuver/time to loss of separation; and 2) projected closest proximity/prescribed separation. The weighting of these ratios shall be adjustable with the exact weighting to be determined during test and evaluation.
4. The CRA function will provide aircraft with the maximum horizontal capability of 180 degree for right or left turns. The baseline software currently limits horizontal maneuvers to 90 degrees in either direction.



## APPENDIX 2. NAS PROGRAM STATUSING AND BASELINE SCHEDULE



CRA PDSR SCHEDULE

ACTIVITY DESCRIPTION	ACTUAL START	ACTUAL FINISH	CURRENT START	CURRENT FINISH
REVIEW AND APPROVAL OF PROPOSED CONTRACT TO BE AWARDED	21-DEC-88	17-JAN-89	21-DEC-88	17-JAN-89
CONTRACT AWARDED (ERSDS CONTRACT)(CIP 12/88)	17-JAN-89	17-JAN-89	17-JAN-89	17-JAN-89
CONTRACTOR PREPARE CONFIG. MGMT PLAN (CRA)	18-JAN-89	28-FEB-89	18-JAN-89	28-FEB-89
PREPARE TECH REQMENTS ANALYSIS & WORK EFFORT REPORT (CRA)	18-JAN-89	10-MAR-89	18-JAN-89	10-MAR-89
DEVELOP CPFS CHANGE PAGES (CRA)	18-JAN-89	23-MAR-89	18-JAN-89	23-MAR-89
SYSTEM REQUIREMENTS REVIEW (SRR) ACTIVITIES (CRAU)	18-JAN-89	31-MAR-89	18-JAN-89	31-MAR-89
PREPARE ACN-100 INTEGRATION TEST PLAN	18-JAN-89	30-AUG-89	18-JAN-89	30-AUG-89
CONTRACTOR SUBMIT CONFIG. MGMT PLAN (CRA)	1-MAR-89	1-MAR-89	1-MAR-89	1-MAR-89
SUBMIT TECH REQMENTS ANALYSIS & WORK EFFORT REPORT (CRA)	13-MAR-89	13-MAR-89	13-MAR-89	13-MAR-89
SUBMIT C.P.F.S. CHANGE PAGES (CRA)	24-MAR-89	24-MAR-89	24-MAR-89	24-MAR-89
SYSTEM DESIGN REVIEW (SDR) ACTIVITIES (CRAU)	4-APR-89	13-APR-89	4-APR-89	13-APR-89
SYSTEM REQUIREMENTS REVIEW (SRR) COMPLETE (CRAU)	18-APR-89	18-APR-89	18-APR-89	18-APR-89
SYSTEMS REQUIREMENTS REVIEW (SRR) COMPLETED (CRAE)	6-SEP-89	6-SEP-89	6-SEP-89	6-SEP-89
SYSTEM DESIGN REVIEW (SDR) COMPLETE (CRAE)	19-DEC-89	19-DEC-89	19-DEC-89	19-DEC-89
A4E1.1 CRAU UPLEVEL TO ATRDEV04	26-JUN-90	28-JAN-91	26-JUN-90	28-JAN-91
SOFTWARE SPECIFICATION REVIEW(CRAE)	10-JUL-90	10-JUL-90	10-JUL-90	10-JUL-90
PRELIMINARY DESIGN REVIEW (PDR) COMPLETED (CRAE)	30-AUG-90	30-AUG-90	30-AUG-90	30-AUG-90
RESOLVE PDR ACTION ITEMS & PUBLISH MEETING MINUTES	31-AUG-90	4-OCT-90	31-AUG-90	4-OCT-90
VALIDATE DRR ITEMS IN DRR CHECKLIST	2-SEP-90	2-SEP-90	2-SEP-90	31-AUG-90

## CRA PDSR SCHEDULE

ACTIVITY DESCRIPTION	ACTUAL START	ACTUAL FINISH	CURRENT START	CURRENT FINISH
HUMAN FACTORS TEST OBJECTIVES (PHASE I)	11-SEP-90	25-SEP-90	11-SEP-90	25-SEP-90
INITIAL DRR CHECKLIST REVIEW	25-SEP-90	25-SEP-90	25-SEP-90	25-SEP-90
HUMAN FACTORS FINAL TEST PLAN (PHASE I)	25-OCT-90	31-JAN-91	25-OCT-90	31-JAN-91
FAA RECEIVE MASTER TEST PLAN DRAFT	2-NOV-90	2-NOV-90	2-NOV-90	2-NOV-90
HUMAN FACTORS SCENARIO DEVELOPMENT (PH I)	3-DEC-90	4-MAR-91	3-DEC-90	4-MAR-91
INITIATE DRR PROCESS	5-DEC-90	5-DEC-90	5-DEC-90	5-DEC-90
FAA DISTRIBUTE FINAL MASTER TEST PLAN FOR REVIEW	30-JAN-91	30-JAN-91	30-JAN-91	30-JAN-91
ACN-100 DEVELOP INTEGRATION TEST PLAN (CRAE)	11-FEB-91		11-FEB-91	1-OCT-91
INITIATE CONTRACT MOD FOR CRAE UPLEVEL	15-FEB-91	15-FEB-91	15-FEB-91	15-FEB-91
CONDUCT CRITICAL DESIGN REVIEW (CRAE)	20-FEB-91	20-FEB-91	20-FEB-91	20-FEB-91
FINAL DESIGN ACTIVITIES (CRAE)	22-FEB-91	28-FEB-91	22-FEB-91	28-FEB-91
RESOLVE CDR ACTION ITEMS & PUBLISH MEETING MINUTES (CRAE)	1-MAR-91	6-MAR-91	1-MAR-91	6-MAR-91
HUMAN FACTORS ZFW ADAPTATION FOR FAATC DYSIM (PHASE I)	5-MAR-91	5-MAR-91	5-MAR-91	5-MAR-91
CONTRACTOR CODE & INFORMAL TESTING	6-MAR-91		6-MAR-91	7-OCT-91
CRITICAL DESIGN REVIEW (CDR) COMPLETED (CRAE)	7-MAR-91	7-MAR-91	7-MAR-91	7-MAR-91
HUMAN FACTORS OT&E SCENARIO SHAKEDOWN TEST (PHASE I)	8-APR-91	12-APR-91	8-APR-91	12-APR-91
PIP COMMENTS TO ANA-300	16-APR-91	16-APR-91	16-APR-91	16-APR-91
FINALIZE PIP	17-APR-91		17-APR-91	29-AUG-91
MOU APPROVED	18-APR-91	18-APR-91	18-APR-91	18-APR-91
PRELIM. HUMAN FACTORS/EARLY OPERATIONAL ASSESSMENT TEST (PHASE I)	23-APR-91	2-MAY-91	23-APR-91	2-MAY-91
HUMAN FACTORS TEST REPORT (PHASE I)	3-MAY-91		3-MAY-91	27-SEP-91
CONTRACT MOD FOR CRAE UPLEVEL COMPLETE			15-JUL-91	15-JUL-91

CRA PDSR SCHEDULE

ACTIVITY DESCRIPTION	ACTUAL START	ACTUAL FINISH	CURRENT START	CURRENT FINISH
FAA MASTER TEST PLAN APPROVED			30-JUL-91	30-JUL-91
HUMAN FACTORS ENHANCEMENT TO PHASE 1 SCENARIOS (PHASE 2)			15-AUG-91	27-AUG-91
APPROVE AND DISTRIBUTE FINAL PIP			30-AUG-91	30-AUG-91
ACN-100 INTEGRATION TEST PLAN APPROVED (CRAE)			2-OCT-91	2-OCT-91
ACN-100 DEVELOP. INTEG. TEST PROCEDURES (CRAE)			3-OCT-91	17-JAN-92
TEST READINESS REVIEW (TRR)			8-OCT-91	8-OCT-91
FORMAL DT&E TESTING			9-OCT-91	8-JAN-92
HUMAN FACTORS TEST OBJECTIVES (PHASE 2)			15-OCT-91	21-OCT-91
HUMAN FACTORS FINAL TEST PLAN (PHASE 2)			22-OCT-91	9-APR-92
CONDUCT PHYSICAL CONFIGURATION AUDIT (PCA)			9-JAN-92	9-JAN-92
CONDUCT FUNCTIONAL CONFIGURATION AUDIT (FCA)			9-JAN-92	9-JAN-92
SYSTEM DELIVERED TO THE TEST & EVAL SITE (FAATC/ACN-120) (CRAE)			10-JAN-92	10-JAN-92
RESOLVE ACTION ITEMS			10-JAN-92	9-MAR-92
ACN-100 INTEG. TEST PROCEDURES APPROVED (CRAE)			21-JAN-92	21-JAN-92
ACN-100 INTEG. TEST READINESS REVIEW (CRAE)			22-JAN-92	22-JAN-92
ACN-100 INTEGRATION TESTING AT FAATC (CRAE)			18-FEB-92	6-MAR-92
ACN-100 INTEGRATION TEST COMPLETED (CRAE)			6-MAR-92	6-MAR-92
ACN-110 TEST REPORT (CRA)			9-MAR-92	12-JUN-92
PHYSICAL CONFIGURATION AUDIT COMPLETED (PCA)			10-MAR-92	10-MAR-92
FUNCTIONAL CONFIGURATION AUDIT COMPLETED (FCA)			10-MAR-92	10-MAR-92

## CRA PDSR SCHEDULE

ACTIVITY DESCRIPTION	ACTUAL START	ACTUAL FINISH	CURRENT START	CURRENT FINISH
CRAE ATRDEV04 COMPLETED			11-MAR-92	11-MAR-92
CRAE UPLEVEL TO A4E1.1 & PTR RESOLUTION			12-MAR-92	18-JUN-92
HUMAN FACTORS/PRELIM. OT&E TEST (PHASE 2)			10-APR-92	13-MAY-92
HUMAN FACTORS TEST REPORT (PHASE 2)			14-MAY-92	13-JUL-92
ATR-400 CONDUCT FCA/PCA			19-JUN-92	2-JUL-92
DRR REPORT DELIVERED TO AAF-1			6-JUL-92	6-JUL-92
DRR EXCOM			10-JUL-92	10-JUL-92
SYSTEM DELIVERED TO THE TEST & EVAL SITE (FAATC/ATR-420)(CRAE A4E1.2)			17-JUL-92	17-JUL-92
ATR-420 START PRODUCTION OF A4E1.2			20-JUL-92	20-JUL-92
ATR-420 PRODUCTION OF A4E1.2			21-JUL-92	29-JUL-93
SYSTEM DELIVERED TO FIRST OPERATIONAL SITE (A4E1.2)			30-JUL-93	30-JUL-93
A4E1.2 KEYSITE TESTING (CRA DISPLAY OFF)			2-AUG-93	14-SEP-93
FIRST ORD COMPLETED (A4E1.2)(CRA DISPLAY OFF)			1-NOV-93	1-NOV-93
ORD AT REMAINING SITES (A4E1.2)(CRA DISPLAY OFF)			2-NOV-93	17-DEC-93
LAST ORD COMPLETED (A4E1.2)(CRA DISPLAY OFF)(CIP 09/94)			20-DEC-93	20-DEC-93
ZFW ORD COMPLETED (CRA DISPLAY OFF) (A4E1.2)			21-DEC-93	21-DEC-93
CRA FIELD TEST AT ZFW			22-DEC-93	7-JUL-94
2ND DRR REPORT DELIVERED TO AAF-1			8-JUL-94	8-JUL-94
FINAL DRR EXCOM (CRA)			15-JUL-94	15-JUL-94
CRA OPERATIONAL AT REMAINING SITES			22-JUL-94	22-JUL-94





## APPENDIX 3. CRA MASTER PROGRAM SCHEDULE

TASK	1989	1990	1991	1992	1993	1994
CRAU A4e0.1 (CSC)	▲ SAR	▲ START IN REPORT	▲ CRAU A4e0.1 COW	▲ PCA	▲ START COMPLETE HANDOFF TO ATR-ADD	▲ START COMPLETE HANDOFF TO ATR-ADD
CRAU ATRDEV04 (CSC)	▲ SAR	▲ START SAR	▲ COW	▲ PCA	▲ START COMPLETE HANDOFF TO ATR-ADD	▲ START COMPLETE HANDOFF TO ATR-ADD
CRAE ATRDEV04 (CSC)	▲ SAR	▲ START SAR	▲ COW	▲ PCA	▲ START COMPLETE HANDOFF TO ATR-ADD	▲ START COMPLETE HANDOFF TO ATR-ADD
CRAE A4e1.1 (CSC)	▲ SAR	▲ START SAR	▲ COW	▲ PCA	▲ START COMPLETE HANDOFF TO ATR-ADD	▲ START COMPLETE HANDOFF TO ATR-ADD
CRAE A4e1.2 (ATR)	▲ SAR	▲ START SAR	▲ COW	▲ PCA	▲ START COMPLETE HANDOFF TO ATR-ADD	▲ START COMPLETE HANDOFF TO ATR-ADD
INTEG. T&E (ACN)						
OT&E (ANA)						
DESIGN VER. (MITRE)						
HUMAN FACTOR (TSC)						
CONTROLLER WG (ZFW)						
TRAINING (ATZ)						
DRR (SEIC)						

